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US Dept. of Commerce Pat. &amp; Trademark Office

Attorney's Docket No.

21551

TRANSMITTAL LETTER TO THE UNITED STATES  
DESIGNATED/ELECTED OFFICE (DO/EO/US)  
CONCERNING A FILING UNDER 35 USC 371

US. Application No. (if known)

09/601377

INTERNATIONAL APP. NO.  
PCT/EP99/06584

INTERNATIONAL FILING DATE  
7 September 1999

PRIORITY DATE CLAIMED  
11 September 1998

TITLE OF INVENTION

REACTOR FOR GASIFYING GRANULAR FUELS WHICH FORM A FIXED BED

APPLICANT(S) FOR DO/EO/US

Gerhard SCHMITT

Applicant herewith submits to the United States Designated/Elected Office (DO/EU/US) the following .

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 USC 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 USC 371.
3. ☐ This is an express request to begin national examination procedures (35 USC 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 USC 317(b) and PCT Articles 22 and 39(1).
4. ☒ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. ☒ A copy of the International Application as filed (35 USC 371(c)(2)).
  - a. ☒ is transmitted herewith (required only if not transmitted by the International Bureau.
  - b. ☐ has been transmitted by the International Bureau.
  - c. ☐ is not required, as the application was filed in the United States Patent Office.
6. ☒ A translation of the International application into English.
7. ☐ Amendments to the claims of the International Application under PCT Article 19 (35 USC 371(c)(3)).
  - a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau.
  - b. ☐ have been transmitted by the International Bureau.
  - c. ☐ have not been made; however the time limit for making such amendments has NOT expired.
  - d. ☐ have not been made and will not be made.
8. ☐ A translation of the amendments to the claims under PCT Article 19 (35 USC 371(c)(3)).
9. ☒ An oath or declaration of the inventor(s) (35 USC 371(c)(4)).
10. ☒ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 USC 371(c)(5)).

Items 11. to 16. below concern documents or information included:

11. ☐ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. ☒ An Assignment for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. ☒ A **FIRST** preliminary amendment.
 ☐ A **SECOND** or **SUBSEQUENT** preliminary amendment.
14. ☐ A substitute specification.
15. ☐ A change of power of attorney and/or address letter.
16. ☒ Other items of information.
  - Drawing (1 sheets)
  - Priority document w/cover letter

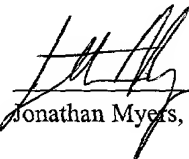
|   |           |  |             |                                       |  |
|---|-----------|--|-------------|---------------------------------------|--|
| US Application no. (if known)<br><b>09/601377</b>   |           | International Application no.<br><b>PCT/EP99/06584</b> |             | Attorney's Docket No.<br><b>21551</b> |  |
| 17. The following fees are submitted:<br>Basic National Fee (37 CFR 1.492(a)(1)-(5):<br>Search report has been prepared by the EPO or JP ..... \$840.00<br>Int'l prel. exam. fee paid to USPTO (37 CFR 1.482) ..... \$670.00<br>No int'l prel. exam. fee paid to USPTO (37 CFR 1.482)<br>but int'l search fee paid to USPTO (37 CFR 1.445(a)(2)) ..... \$690.00<br>Neither int'l prel. exam fee (37 CFR 1.482) nor<br>int'l search fee (37 CFR 1.455(a)(2)) paid to USPTO ..... \$970.00<br>Intl. prel. exam. fee paid to USPTO (37 CFR 1.482)<br>and all claims satisfied provisions of PCT Art. 33(2-4) ..... \$96.00<br><br>ENTER APPROPRIATE BASIC FEE AMOUNT |           |  |             | CALCULATIONS PTO USE ONLY             |  |
| Surcharge of \$130.00 for furnishing oath or declaration later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492(e)).   |           |  |             |                                       |  |
| CLAIMS  | NO. FILED | NO. EXTRA  | RATE        |                                       |  |
| Total claims  | <b>6</b>  | <b>0</b>   | <b>\$18</b> | <b>\$0</b>                            |  |
| Ind. claims   | <b>0</b>  | <b>0</b>   | <b>\$78</b> | <b>\$0</b>                            |  |
| MULTIPLE DEP. CLAIM(S) (if applicable) (see prel. amt.)   |           |  | <b>260</b>  |                                       |  |
| TOTAL OF ABOVE CALCULATIONS   |           |  |             | <b>\$970</b>                          |  |
| Reduction of 1/2 for filing by small entity, if applicable. Verified Small Entity Statement must also be filed (37 CFR 1.2, 1.27, 1.28)   |           |  |             | <b>\$0</b>                            |  |
| SUBTOTAL  |           |  |             | <b>\$970</b>                          |  |
| Processing fee of \$130.00 for furnishing the English translation later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492(f)).  |           |  |             |                                       |  |
| TOTAL NATIONAL FEE  |           |  |             | <b>\$970</b>                          |  |
| Fee for recording the enclosed assignment (37 CFR 1.21(h)). The Assignment may be accompanied by an appropriate PTO-1595 cover sheet (37 CFR 3.28, 3.39)  |           |  |             | <b>\$40</b>                           |  |
| TOTAL FEES ENCLOSED   |           |  |             | <b>\$1,010</b>                        |  |
|   |           |  |             | Amt to be refunded                    |  |
|   |           |  |             | Amt to be charged                     |  |

- a. ☒ A check in the amount of \$970 to cover the above fees is enclosed  
☒ A check in the amount of \$40 to cover recordal of the Assignment  
b. ☐ Please charge my deposit account 18-2025 \$00.00 to cover the above fees. A copy of this sheet is enclosed.  
c. ☒ The commissioner is authorized to charge any additional fees which may be required or credit any overpayment to deposit account 18-2025. A copy of this sheet is enclosed

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

Send all correspondence to:

**The Firm of Karl F. Ross P.C.**  
**5676 Riverdale Ave. Box 900**  
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Jonathan Myers, Reg. No. 26,963

09/601377

534 Rec'd PCT/PTC 27 JUL 2000

21551

IN THE U.S. PATENT AND TRADEMARK OFFICE

Inventor                      Gerhard SCHMITT  
Patent App.                  Not known (US Nat'l phase of PCT/EP99/06584)  
Filed                          Concurrently herewith  
For                            REACTOR FOR GASIFYING GRANULAR FUELS WHICH FORM  
                                 A FIXED BED  
Art Unit                      Not known  
Hon. Commissioner of Patents  
Washington, DC 20231

PRELIMINARY AMENDMENT

Prior to examination of the above-identified application,  
please amend as follows:

In the Claims:

Claim 3, line 1, delete "or 2",

Claim 6, lines 1 and 2, delete "or any of the preceding  
claims".

This preliminary amendment is submitted just to reduce  
claim charges.

Respectfully submitted,  
The Firm of Karl F. Ross P.C.

  
by: Jonathan Myers, 26,963

Attorney for Applicant

rg  
26 July 2000  
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09/601377

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Translation of PCT/EP99/06584

Reactor for Gasifying Granular Fuels which Form a Fixed Bed

Description

This invention relates to a reactor for gasifying granular fuels, where the fuel in the reactor forms a fixed bed in whose lower portion oxygen-containing gasifying medium is introduced, which moves upwards in the fixed bed, and where product gas containing hydrogen and carbon oxides is discharged from the reactor through a discharge duct above the fixed bed.

Reactors of this kind have long since been known and are described for instance in the U.S. patent 5,094,669, the EP patent 0,078,100 and the GB patent 2,003,589. The gasification is effected by means of a rotary grate in the reactor and the discharge of solid ash, or without rotary grate with discharge of liquid slag.

As fuel, all kinds of coal are used including lignite and peat, to which various waste substances may be added. When the fuel added to the fixed bed from the top is too fine-grained, a disturbingly large amount thereof is withdrawn

from the reactor by the product gas and transported into the subsequent apparatuses. This may lead to operating failures which require the shut-down of the reactor. By increasing the maximum performance of a reactor and thus increasing the generation of product gas, it may also happen that the product gas stream withdraws too much fine-grained fuel from the reactor.

It is the object underlying the invention to design the above-mentioned reactor such that even with a strong product gas stream no disturbing amounts of fine-grained fuel are withdrawn from the reactor. In accordance with the invention this is achieved in that in the reactor at least one centrifugal separator is disposed for separating solids from the product gas, which centrifugal separator has an inlet opening for dust-laden product gas coming from the fixed bed, an outlet line for product gas, and a solids discharge line leading into the fixed bed, where the outlet line is connected with the discharge duct of the reactor.

Advantageously, several centrifugal separators are disposed in the reactor, where the outlet lines of the separators open into an annular chamber disposed in the upper portion of the reactor, which annular chamber communicates with the discharge duct.

An expedient embodiment of the invention consists in that in the upper portion of the reactor a vertical annular wall is provided, and that the inlet opening of the separator is disposed outside the portion of the reactor enclosed by the annular wall. The annular wall ensures that the inlet opening of the separator is disposed above the fixed bed.

Ideally, the cyclone is used as centrifugal separator, but other centrifugal separators may be used as well. The reactors usually operate at pressures of 1 to 80 bar.

Embodiments of the reactor are illustrated with reference to the drawing, wherein:

Fig. 1 is a schematic representation of a gasification reactor with rotary grate in a longitudinal section, and Fig. 2 shows a second reactor variant in the representation analogous to Fig. 1, and Fig. 3 shows a further reactor variant.

The reactor shown in Fig. 1 has a casing 1, which usually is water-cooled. The granular fuel comes from the reservoir 2 and drops through the valve 3, which is open at this time, onto the fixed bed 4. In the lower portion of the reactor a rotary grate 5 is provided, to which a mixture of oxygen and steam is supplied through a gasifying medium line 6, which mixture is distributed from the rotary grate 5 into the fixed bed 4. In a manner not represented in detail, ash is withdrawn downwards through the opening 7.

The energy required in the endothermal gasification reactions is provided by partial oxidation. The crude product gas leaves the reactor through the discharge duct 9 and is supplied to a cooling and cleaning. At its upper end, a vertical annular wall 10 is connected with the reactor casing 1 in a gastight manner and serves as boundary for an annular chamber 11 which communicates with the discharge duct 9. A horizontal partition 12 in the form of an annular disk is disposed between the casing 1 and the annular wall 10 as lower boundary of the annular chamber 11.

In Fig. 1, two cyclones 13 are represented, whose outlet lines 14 extend upwards into the annular chamber 11. The inlet opening 15 of each cyclone 13 is disposed below the partition 12 and above the fixed bed 4. Dust-laden product gas, which flows out of the fixed bed 4, is forced through the openings 15 into one of the two cyclones 13, where the

separated solids are recirculated through the respective solids discharge line 16 into the fixed bed 4. For a better downward discharge of the solids, the lower portion of the discharge line 16 is expanded. The number of cyclones may be chosen as desired, and will usually be 1 to 10.

The product gas leaving the cyclones 13 flows through the outlet lines 14 first into the annular chamber 11 and then to the discharge duct 9. The dust content of this product gas is limited in this way, so that operating failures are avoided.

In accordance with Fig. 2, the cyclones 13 are disposed inside the portion enclosed by the annular wall 10 and thus more or less in the fixed bed 4, where the temperatures are relatively low. In the arrangement shown in Fig. 1, the cyclones 13 are disposed outside the annular wall 10, and product gas flows around them. The reference numerals of Fig. 2 have the meaning already explained in conjunction with Fig. 1.

The schematically illustrated reactor shown in Fig. 3 only has a cyclone 13, whose outlet line 14 is directly connected with the discharge duct 9. Dust-laden product gas, which comes from the fixed bed 4, flows into the cyclone through the opening 15, and separated solids are recirculated to the fixed bed 4 through the discharge line 16. The nozzles 20 are used for supplying the gasification medium, and liquid slag is withdrawn through the outlet 7a.

A gasification reactor with rotary grate 5, as it is represented in Fig. 1 or 2, can easily be equipped with only one cyclone 13 in accordance with Fig. 3, and the reactor shown in Fig. 3, which operates with the discharge of liquid slag, can likewise have several separating cyclones 13, as was explained in conjunction with Fig. 1 or Fig. 2.

### Claims

1. A reactor for gasifying granular fuels, where the fuel in the reactor forms a fixed bed in whose lower portion oxygen-containing gasification medium is introduced, which moves upwards in the fixed bed, and where product gas containing hydrogen and carbon oxides is withdrawn from the reactor through a discharge duct above the fixed bed, characterized in that in the reactor at least one centrifugal separator is provided for separating solids from the product gas, which has an inlet opening for dust-laden product gas coming from the fixed bed, an outlet line for product gas, and a solids discharge line leading into the fixed bed, where the outlet line is connected with the discharge duct of the reactor.
2. The reactor as claimed in claim 1, characterized in that several centrifugal separators are disposed in the reactor and the outlet lines of the separators open into an annular chamber disposed in the upper portion of the reactor, which annular chamber communicates with the discharge duct.
3. The reactor as claimed in claim 1 or 2, characterized in that in the upper portion of the reactor a vertical annular wall is provided, and that the inlet opening of the separator is disposed outside the portion of the reactor enclosed by the annular wall.
4. The reactor as claimed in claim 3, characterized in that the separator is disposed outside the portion enclosed by the annular wall.
5. The reactor as claimed in claim 3, characterized in that the separator is disposed inside the portion enclosed by the annular wall.



6. The reactor as claimed in claim 1 or any of the preceding claims, characterized in that the centrifugal separator constitutes a cyclone.

21551

**DECLARATION AND POWER OF ATTORNEY**

As a below named inventor, I hereby declare that: My residence, post-office address, and citizenship are as stated below next to my name,  
I believe that I am the original, first, and sole inventor of the subject matter which is claimed and for which a patent is sought on the invention entitled

**REACTOR FOR GASIFYING GRANULAR FUELS WHICH FORM A FIXED BED**

the specification of which was filed on 7 September 1999 as PCT application PCT/EP99/06584.

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56.

I hereby claim foreign priority benefits under 35 USC 119 of any foreign applications for patent or inventor's certificate listed below and have also identified below any foreign applications for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

**Prior Foreign Applications**

| Country | Number     | Filing Date       | Priority claimed |
|---------|------------|-------------------|------------------|
| DE      | 19841586.9 | 11 September 1998 | Yes              |

I hereby claim the benefit under 35 USC 120 of the United States Application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States Application(s) in the manner provided by the first paragraph of 35 USC 112, I acknowledge the duty to disclose material information as defined in 37 CFR 1.56 which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

| Serial Number  | Filing Date      | Status  |
|----------------|------------------|---------|
| PCT/EP99/06584 | 7 September 1999 | Pending |

I hereby appoint as attorneys to prosecute this application and to transact all business connected therewith: Herbert Dubno, Reg. 19,752; Jonathan Myers, Reg. 26,963; Andrew Wilford, Reg. 26,597 and each of them individually.

Address all correspondence to:

**The Firm of Karl F. Ross, P.C.**  
**Customer Number 535**

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 USC 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full name of sole inventor:

Gerhard SCHMITT

Inventor's signature

Date: 24/07/2000

Residence: Schmitten, Germany

Citizen of Germany

Post-office Address: Weihgrundstrasse 20, D-61389 Schmitten, Germany